

Effects of Active Product Mixes on Spray Atomization

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Objective

- Examine real world tank mixes (active product with and without adjuvants) for atomization characteristics under aerial application conditions:
 - How do they compare to “Blanks”?
 - Can scaling factors be developed based on physical properties for use with current spray atomization models?

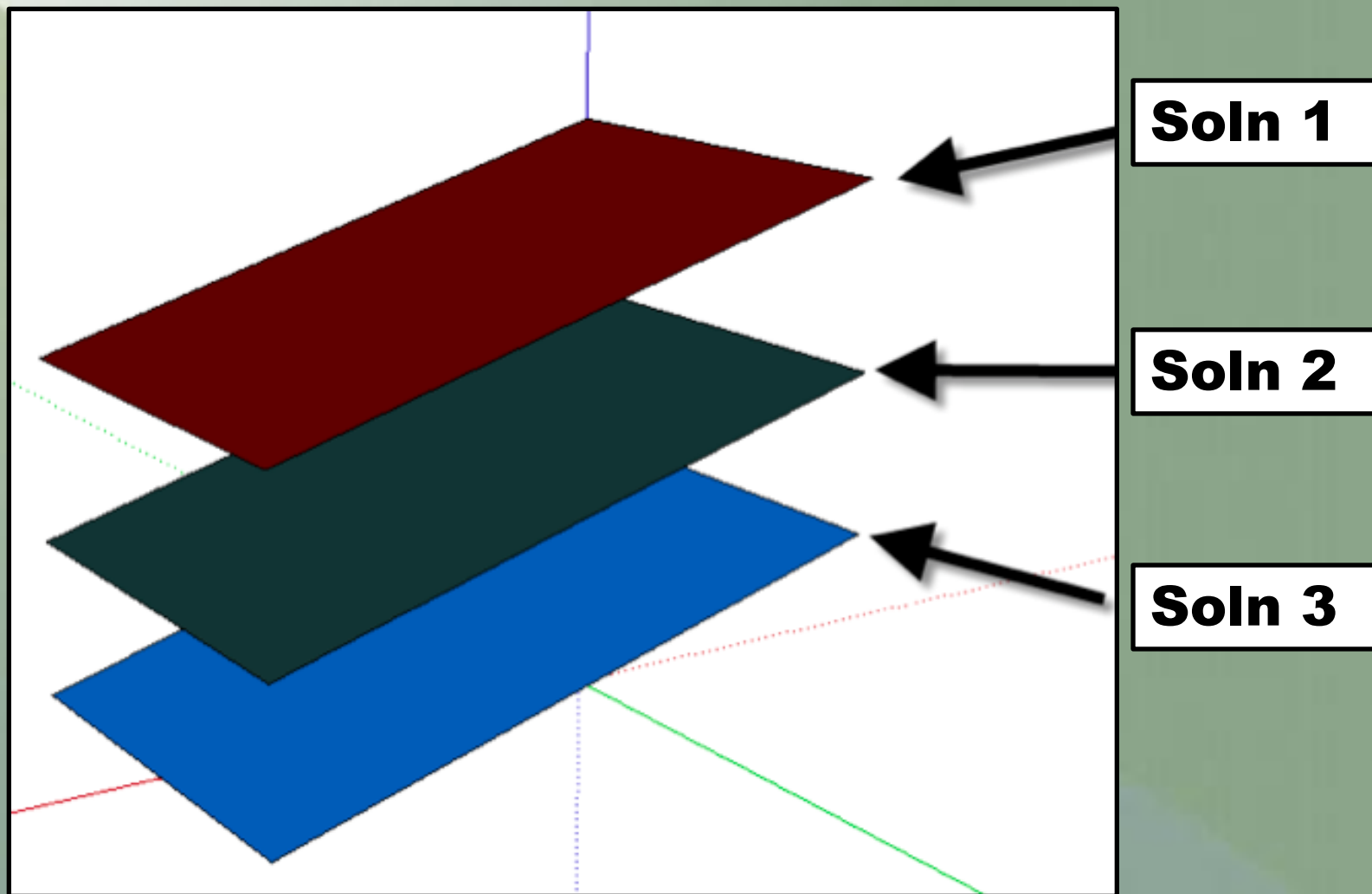
Methods – Models

- Current nozzle model experimental design used to assign operational settings for a 40 degree flat fan nozzle.
 - Predictive model defined by four parameters each at three levels:
 - Orifice size
 - Spray angle
 - Pressure
 - Airspeed

Treatments

- 40 degree flat fan nozzle
 - 27 treatments
 - Orifice levels – 4, 15, 30
 - Deflection Angle – 0, 45, 90°
 - Pressure – 20, 40, 60 psi
 - Airspeed – 120, 160, 200 mph
- The results from the defined 27 operational settings define the predictive model (response surface) for each droplet size parameter (D_{V10} , D_{V50} , D_{V90} , etc...)

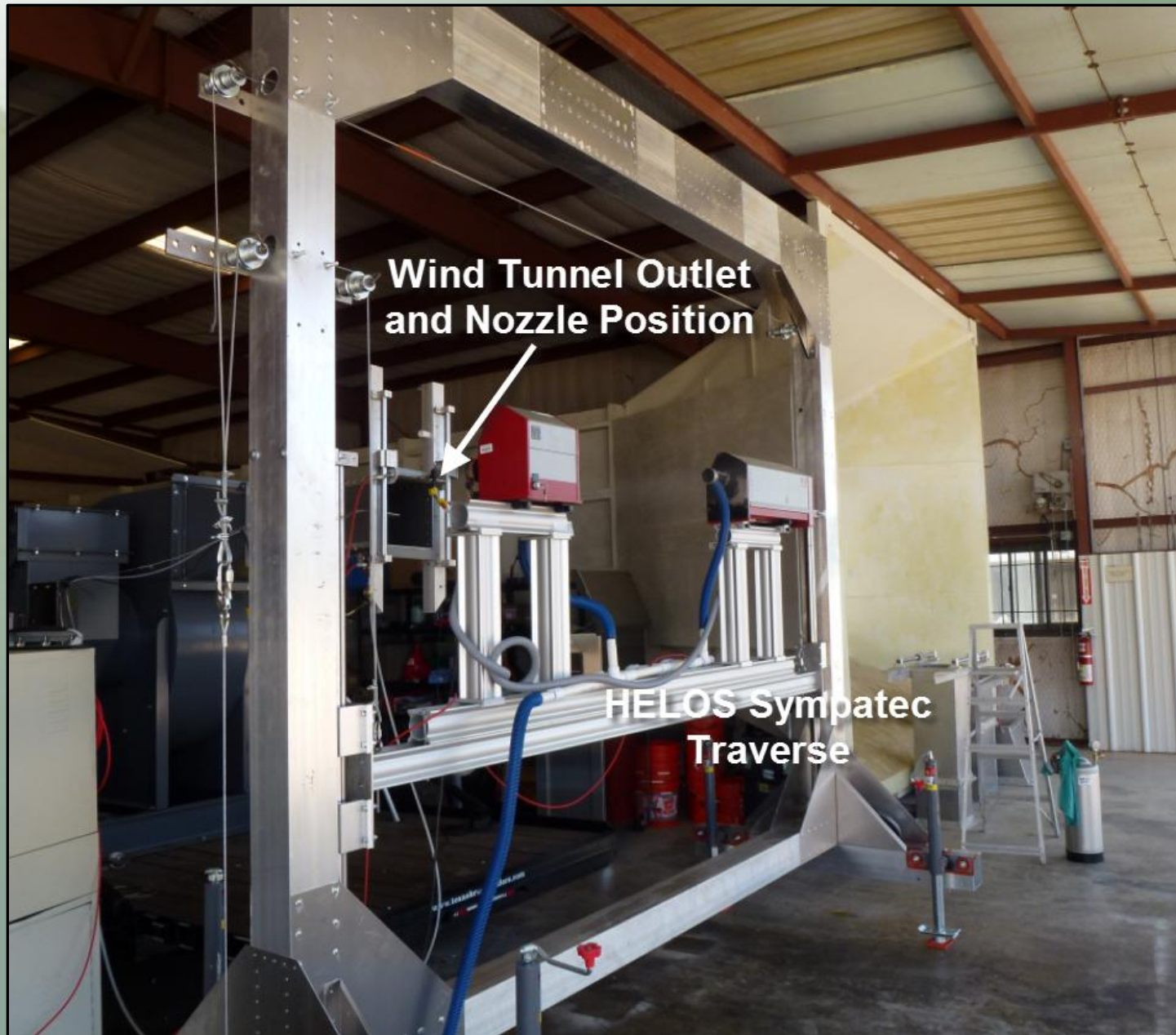
Methods – Predictive Model Response Surface



Spray Solutions

Solution	PowerMAX (PM)	Adjuvant Type and Mixing Rate (volume of adjuvant added)
1		none
2		90% non-ionic surfactant
3	X	none
4	X	90% non-ionic surfactant
5	X	methyated seed oil
6	X	high surfactant oil concentrate
7	X	crop oil concentrate
8	X	oil/surfactant blend
9	X	invert emulsion
10	X	micro emulsion
11	X	silicone
12	X	petroleum polymer

Droplet Sizing



Data Analysis

- Compared change in droplet size across all 27 points for each solution and compared to water + NIS.
 - Solution DS / Water+NIS DS
 - Tried to correlate solution physical properties to change in droplet size to develop correction factor.
- Compared predicted results from current models to the newly developed models.

Solution Droplet Size as a Percent of Water + NIS Droplet Size

Solution	5 – 10% Reduction with little significant separation between solutions					
3 - PM only	93	a		95	b	99 e
4 - PM + NIS	91	a		93	b	96 de
5 - PM + MSO	89	a		85	a	86 a
6 - PM + HSOC	92	a		93	b	95 cde
7 - PM + COC	97	a		95	b	93 bcde
8 - PM + O/S	97	a		91	ab	88 abc
9 - PM + IE	91	a		87	a	87 ab
10 - PM + ME	93	a		91	ab	91 abcd
11 - PM + Si	91	a		93	b	96 cde
12 - PM + PP	96	a		97	b	97 de

Results

No consistent change across all operational points.

No significant correlation to physical properties.

Prevents the development and use of a Correction Factor for current models.

**Original
Surface**

**Real World
Application
Surface**

Observations

- PM solutions resulted in droplet sizes that:
 - Averaged 5-10% less than water + NIS solutions
 - However, differences across all operational settings ranged from 50 to 150%.
- Little separation between adjuvants.
 - Minor differences in physical properties;
 - Air shear effect is dominate.
 - NOTE: This may not be true for other active
- Water plus NIS not a sufficient mimic for all PM tank mixes
 - Product specific models for specific nozzles a likely solution.
 - products or nozzles – Topic of further study

Current Models

- Developed over the past 10 years.
- Used Particle Measurement System Optical Array Probe
 - Does not measure drops below 34 μm
 - Overestimates overall distribution
- Limited to 160 mph
- Out of sync with all recently (<5 years) collected spray atomization data.

Observations

- Present models overestimate droplet size 20 – 30% as compared to measurements made with improved systems and methods.
 - Current models DO give accurate estimates of the spray quality in terms of Droplet Size Classification.
 - I.e. a MEDIUM nozzle in the current model will, in most cases, be a MEDIUM nozzle in the new models.

Future Plans

- Developing “new” models.
 - Timeline: Models in place by the end of April 2012.
- Develop product specific models for specific nozzles.
 - Need industry feedback on direction.
 - Timeline: As they are completed throughout 2012.
 - NOTE: We cannot do ALL product/nozzle combinations but would like to focus on widely used combinations first.
- Update the mobile applications with the new models.
 - Timeline: Fall 2012